

# Bitterroot Valley Project

Montana Department of Agriculture  
Groundwater Protection Program

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# Montana Department of Agriculture

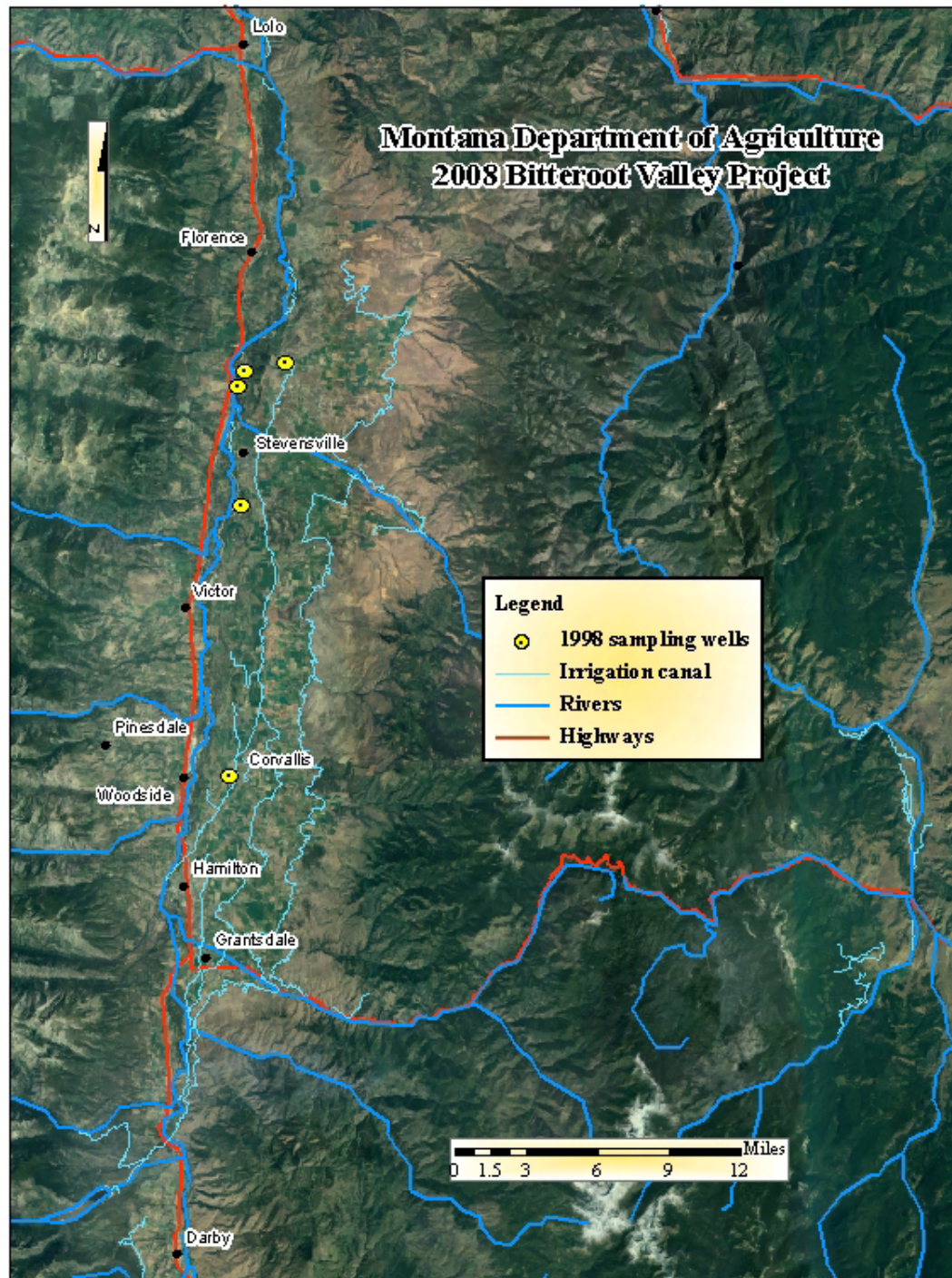
- In 1989, the Montana Agricultural Chemical Groundwater Protection Act was passed (MCA Title 80, Chapter 15, Sections 80-15-101 through 80-15-414). Section 80-15-103 states that it is the policy of the state to:
  - protect groundwater and the environment from impairment or degradation due to the use of agricultural chemicals
  - allow for the proper and correct use of agricultural chemicals
  - provide for the management of agricultural chemicals to prevent, minimize, and mitigate their presence in groundwater
  - provide for education and training of agricultural chemical applicators and the general public on groundwater protection, agricultural chemical use, and the use of alternative agricultural chemicals

# Bitterroot Valley Agriculture

- Agricultural production
  - Irrigated hay and pasture
  - Irrigated corn
  - Dryland wheat and barley
  - Orchards
  - Nursery stock
- Conversion of agricultural land to residential development is the major land use change

# Previous Work

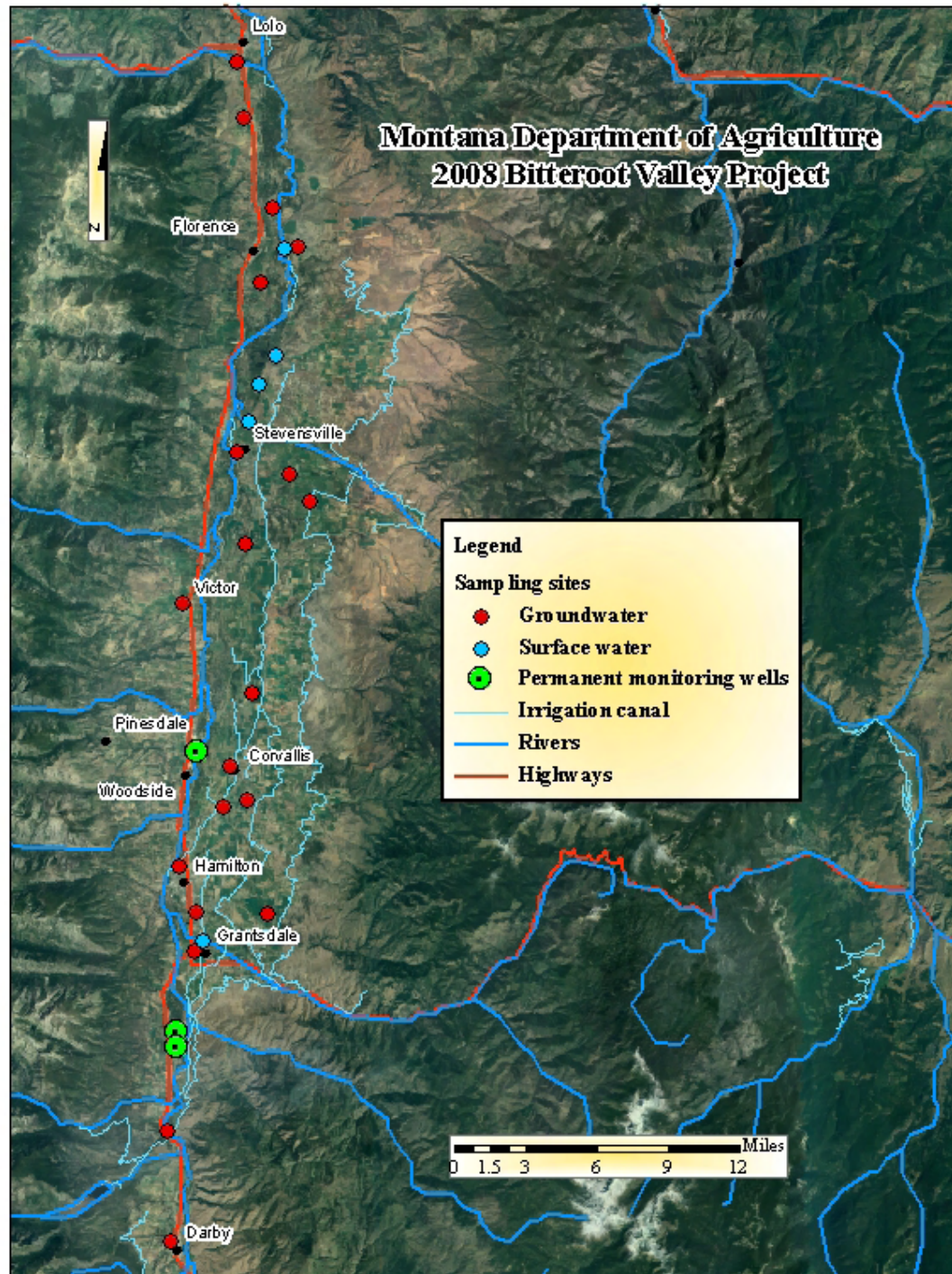
- Groundwater samples collected from 5 wells in 1998 in the valley
- Tested for 20 different pesticides and analytes
  - 15 of 20 analytes are still part of Universal Method
- No detections in 1998 sampling
  - Laboratory analyses much less sensitive in 1998 versus 2008
  - Limit of Quantification is now much lower (ppt)





# Project Scope

- Project area: Lolo to Darby in the Bitterroot Valley
- Shallow groundwater wells ( $\leq 50$  ft;  $\bar{x} = 39$  ft.) ( $n = 23$ )
- Range of land use
  - Established residential
  - New development (since 1990)
  - Agriculture
- Surface water sites ( $n = 5$ )
- All samples analyzed for 95 different pesticides and degradates and for nitrate/nitrite
  - ASD Laboratory at MSU-Bozeman
- 2 sampling events: June 16-17 and September 15-16



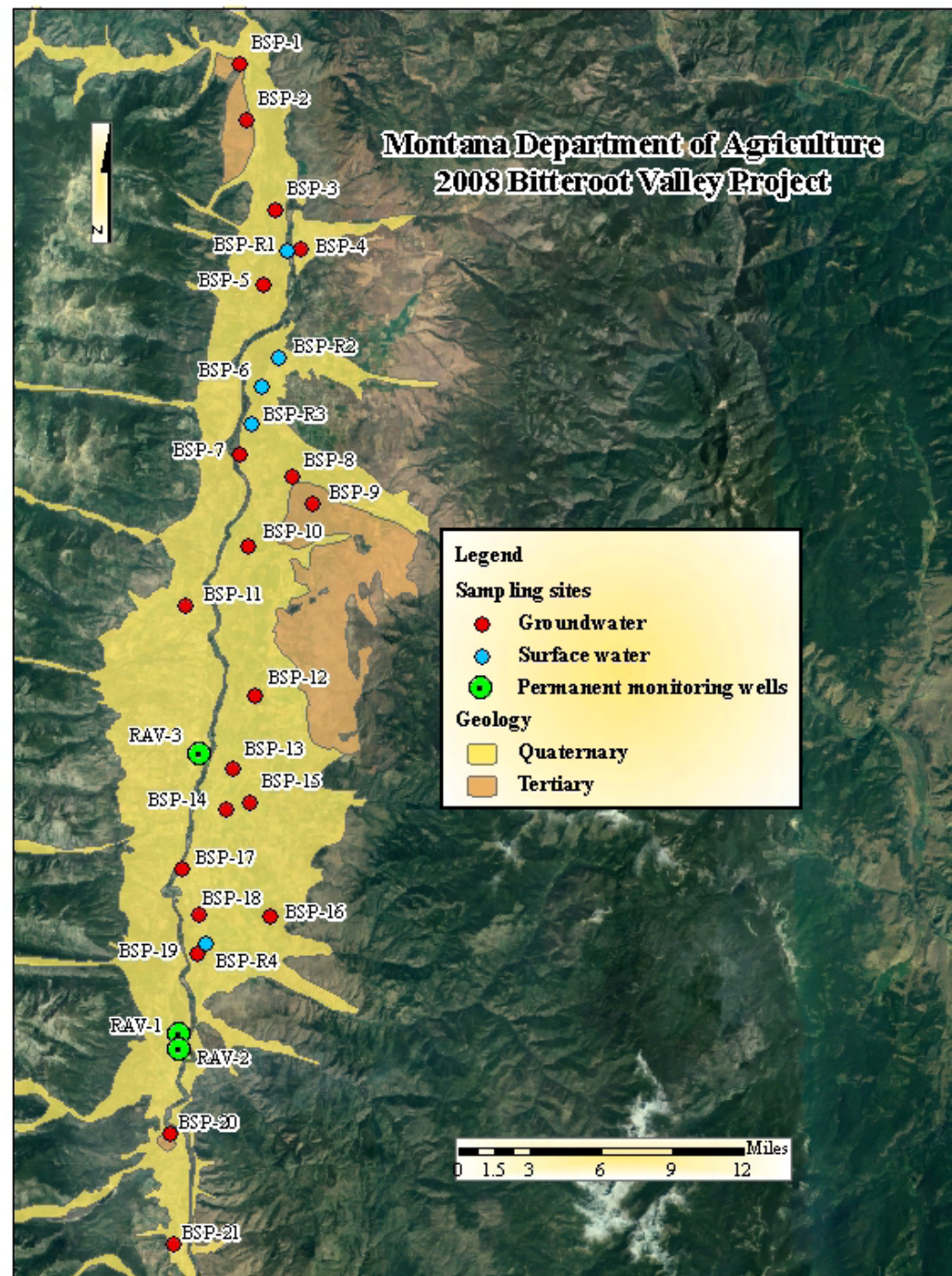
## Hydrogeology and Aquifer sensitivity of the Bitterroot valley, Ravalli County, MT (Briar and Dutton, 2000)

- Aquifers in the various basin-fill deposits are either unconfined, semi-confined, or confined; most aquifers in Quaternary alluvium, terrace deposits and alluvial-fan deposits are unconfined to semi-confined and yield abundant water to wells
- Hydraulic characteristics did not vary significantly between the eastern and western sides of the valley.
- The alluvium beneath the low terraces and the flood plain of the Bitterroot River generally has the greatest water-transmitting and storing capacity of any aquifer in the valley.
- Valley-floor contains 305 square miles. The pervious soils and extensive farming generally prevent surface runoff, except during storms of high intensity or during snowmelt while the ground is frozen.



## Geology and Water Resources of the Bitterroot Valley, Southwestern Montana (McMurtrey et al., 1972)

- The rate of flow of **GROUNDWATER** is slow in comparison with that of surface water and was estimated to be 400 feet per year through Tertiary sand, 700 feet per year through alluvium beneath the flood plain, and 1,000 feet per year through the alluvium west of the river.
- Each spring and summer, at rates greatly exceeding discharge, water infiltrates to the ground-water reservoir in the Tertiary and Quaternary rocks. During the fall and winter, water is released from storage.
- In general, the water level gradually declines through the winter and early spring, and then rises rapidly in May and June in response to recharge from precipitation and irrigation.



# Results: groundwater wells

- Observations ranged from ND (non-detect) to  $0.1 \mu\text{g/L}$  (ppb)
- 1 part-per-billion is equivalent to 1 drop of water diluted into 250 chemical drums ( $50 \text{ m}^3$ ), or one second of time in approximately 31.7 years.
- 1 part-per-trillion is equivalent to 1 drop of water diluted into 20, two-meter-deep Olympic-size swimming pools ( $50,000 \text{ m}^3$ ), or one second of time in approximately 31,700 years.

## Summary of Pesticide Detections in Groundwater

Analyte (and Common Trade Names) (µg/L)																	
		Tebuthiuron (Spike)	5	0.006	500												
		Simazine (Simazat, Simazine)	4	0.007	4												
		Prometon (Pranitol)	18	0.042	100												
		Metolachlor ESA	2	Q	--												
		Metolachlor (Cinch, Parrallel)	1	Q	100												
		MCPA (Encore)	2	0.003	4												
		Imazapyr (Arsenal, Chopper)	1	Q	21,000												
		Imazamethabenz methyl ester (Assert)	1	Q	400												
		Hexazinone (Velpar)	2	Q	400												
		Ethofumesate (Norton, Progress)	2	0.051	--												
Deethyl atrazine	6	Q	--														
Chlorsulfuron (Cimarron, Telar)	1	Q	1750														
Carbofuran (Furadan)	1	0.01	40														
Atrazine (Atrazine, Aatrex)	3	0.011	3														
Aminopyralid (Milestone)	1	0.1	--														
Aldicarb sulfone	1	0.012	3														
2,4-D (numerous)	2	Q	70														
Total detections																	
Max. observation (µg/L)																	
Drinking Water Standard (µg/L)																	

µg/L = micrograms per liter (1 µg/L = 1 part per billion)

Q = analyte detected below analytical method limit of quantitation



[illegible]

	Imazamethabenz methyl ester	Imazapyr	MCPA	Metolachlor	Metolachlor ESA	Prometon	Simazine	Tebuthiuron
BSP-1								
BSP-2						XX		
BSP-3								
BSP-4								
BSP-5				X				
BSP-7	X					XX	X	XX
BSP-8						XX		
BSP-9								
BSP-10								
BSP-11						XX		
BSP-12								
BSP-13					X	XX	XX	XX
BSP-14						XX		
BSP-15		X				XX		
BSP-16								
BSP-17						XX	X	X
BSP-18						XX		
BSP-19					X			
BSP-20								
BSP-21								
RAV-1			X					
RAV-2								
RAV-3			X					

# Results: groundwater wells

- All detections were near or below detection limits; Human Health Standards never exceeded
- 8 of 21 groundwater wells and 1 PMW had **NO** pesticide detections
- Triazine herbicides were the most common detections (atrazine, simazine, prometon)
- Soil sterilants used in non-crop uses often have long half-lives and degrade slowly *in situ*

## Summary of Pesticide Detections in Surface Water

		Analyte (and Common Trade Names) (µg/L)							
		2,4-D (numerous)	Aldicarb (Tenik)	Aldicarb sulfone	Diuron (Karmex, Velpar)	Ethofumesate (Norton, Progress)	Hexazinone (Velpar)	Imazapyr (Arsenal, Chopper)	Metolachlor ESA
<b>Total detections</b>		<b>5</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Max. observation (µg/L)</b>		<b>0.0074</b>	<b>Q</b>	<b>Q</b>	<b>Q</b>	<b>0.0032</b>	<b>Q</b>	<b>Q</b>	<b>Q</b>
<b>Drinking Water Standard (µg/L)</b>		<b>70</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>--</b>	<b>400</b>	<b>21,000</b>	<b>--</b>
<b>Chronic invertebrates (aquatic life benchmark) (µg/L)</b>		<b>16,400</b>	<b>1</b>	<b>--</b>	<b>160</b>	<b>320</b>	<b>50,000</b>	<b>--</b>	<b>--</b>

µg/L = micrograms per liter (1 µg/L = 1 part per billion)

Q = analyte detected below analytical method limit of quantification

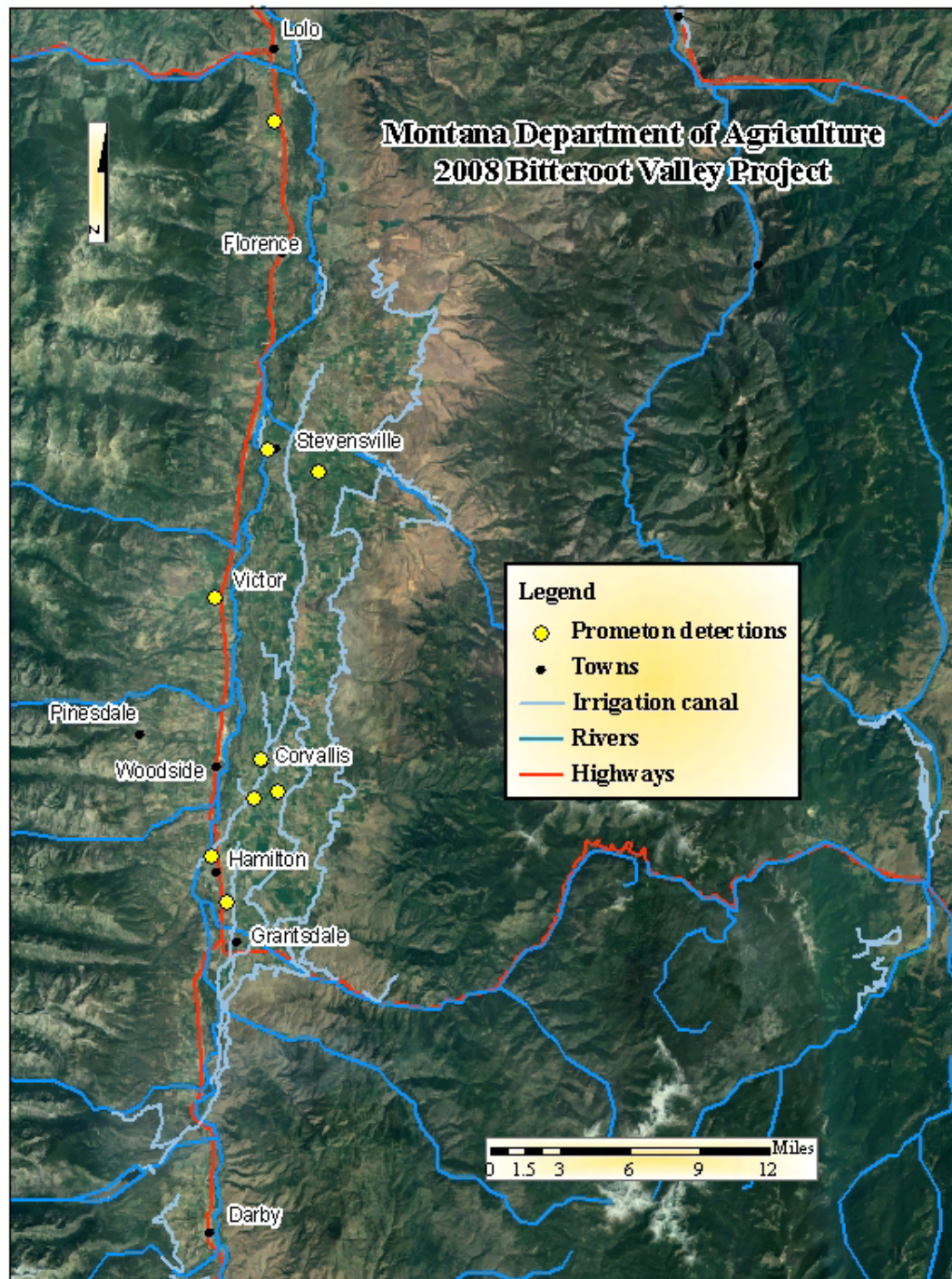
Chronic invertebrates (aquatic life benchmark) - 21 day average No Observed Effect Level (NOEL)



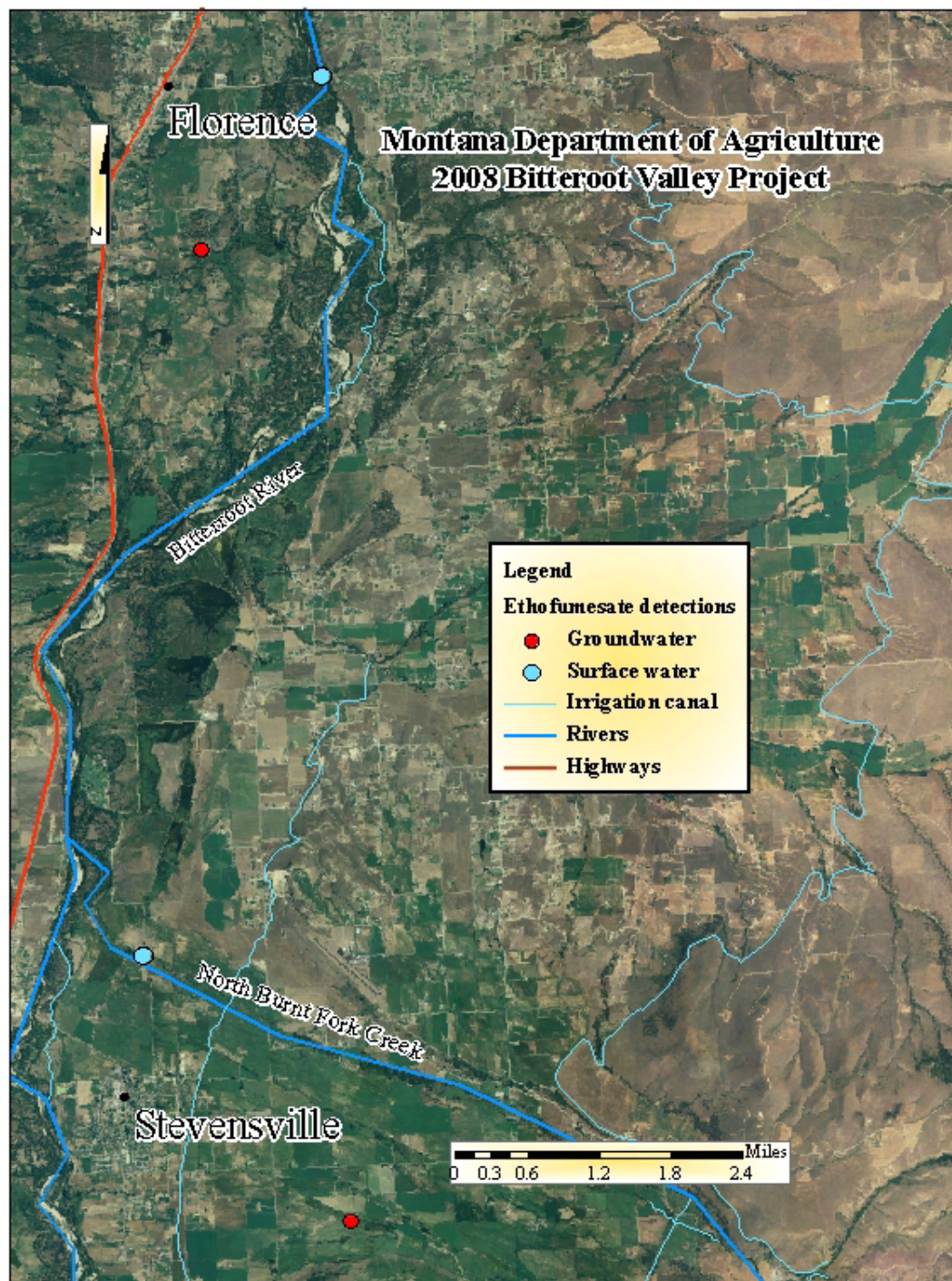
# Results: surface water

	2,4-D	Aldicarb	Aldicarb sulfone	Diuron	Ethofumesate	Hexazinone	Imazapyr	Metolachlor ESA
BSP-6							X	
BSP-R1	X			XX	X	X	X	X
BSP-R2	XX							
BSP-R3	XX	X	X		X			
BSP-R4				XX				

- BSP-6 – groundwater drain/ditch system
- R1 – Bitterroot River at East Side Highway bridge
- R2 – Threemile Creek at Rathburn Lane
- R3 – North Burnt Fork Creek at Wild Fowl Lane
- R4 – Skalkaho Creek at Grantsdale Road bridge







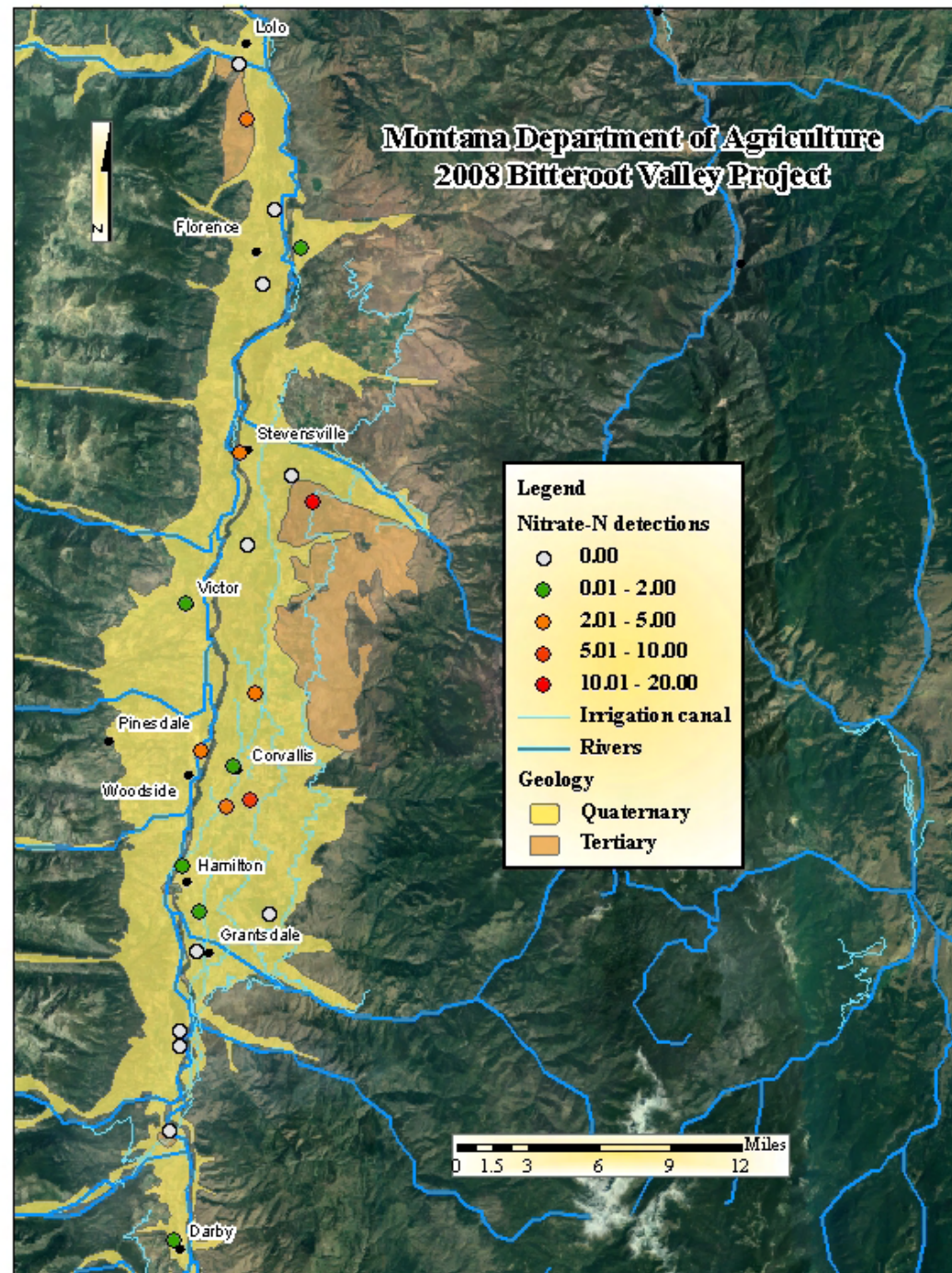
# Pesticides

- Most common detection: **Prometon**
- Highest detection: **Aminopyralid**
- Most surprising detection: **Ethofumesate**



# Nitrate-N

- 7 of 21 groundwater wells and 2 PMWs had **NO** nitrate-N detections
- Overall  $\bar{x} = 1.70$  ppm; median = 1.05 ppm
- 6 groundwater wells and 1 PMW exceeded natural background levels (2 ppm)
- 1 groundwater well exceeded HHS (10 ppm)



## Hydrogeology and Aquifer sensitivity of the Bitterroot valley, Ravalli County, MT (Briar and Dutton, 2000)

- The median nitrate concentration for the 239 wells sampled from 1993-1996 was 0.63 ppm. 20 wells exceeded 3 ppm. Maximum was 5.9 ppm. Median from west-side sediments was 0.17 ppm, ( $n=83$ ) and from the east-side sediments 1.05 ppm ( $n=143$ ) – 6X the median of the west-side

Ground-water quality in shallow basin-fill, deep basin-fill and bedrock aquifers, Bitterroot Valley, Missoula and Ravalli counties, southwest Montana (LaFave, 2006)

- Study included nitrate-N data from Briar and Dutton, 2000 and previous studies completed by MBMG and UM
- Median nitrate-N in all hydrologic units was less than 1 ppm
- Nitrate-N was detected at about 75% of sites; 17% (41) sites higher than 2 ppm
- Only HHS exceedance came from a fractured bedrock aquifer



# Conclusions

- No pesticides were observed in exceedance of Human Health Standards
- Nitrate-N was elevated in a few wells but overall fell within natural background levels (2 ppm)
- Fewer detections observed in southern, more undeveloped part of the valley

# Conclusions

- Rapid and continued population growth and the resulting widespread residential development probably represent the greatest potential for change to water quality in the study area (Briar and Dutton, 2000)
- Aquifers in many parts of the study area are relatively susceptible to potential contamination from surface or near-surfaces sources because the coarse-grained character of the near-surface sediments could allow contaminants to readily infiltrate.

# Literature Cited

- Briar, D.W., and Dutton, D.M., 2000, Hydrogeology and aquifer sensitivity of the Bitterroot Valley, Ravalli County, Montana: [U.S. Geological Survey Water-Resources Investigations Report 99-4219](#), 114 p.
- LaFave, J.I., 2006, Ground-water quality in shallow basin-fill, deep basin-fill and bedrock aquifers, Bitterroot Valley, Missoula and Ravalli counties, southwest Montana (open-file version): Montana Bureau of Mines and Geology Ground-Water Assessment Atlas 4B-09, 1 sheet, 1:500,000.
- McMurtrey, R.G., Konizeski, R.L., Johnson, M.V., and Bartells, J.H., 1972, Geology and water resources of the Bitterroot Valley, southwestern Montana with a section on Chemical quality of water by H.A. Swenson: [U.S. Geological Survey Water-Supply Paper 1889](#), 80 p.

# MDA Contacts

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- <http://agr.mt.gov/pestfert/groundWater.asp>
  - Follow link to monitoring reports



# Questions?

